AIR PRESSURE

Air around us has weight and it presses down on the Earth's surface. This weight of air is called air pressure. Air is made up of molecules that are pulled towards the earth by **gravity**. The air pressure can be measured by using mercury barometer, aneroid barometer and a barograph.

Air pressure is also called **barometric pressure** or **atmospheric pressure**.

Air pressure is measured in ***millibars*** (**mb**). At sea level air pressure is **1013.15mb**.

FACTORS INFLUENCING AIR PRESSURE

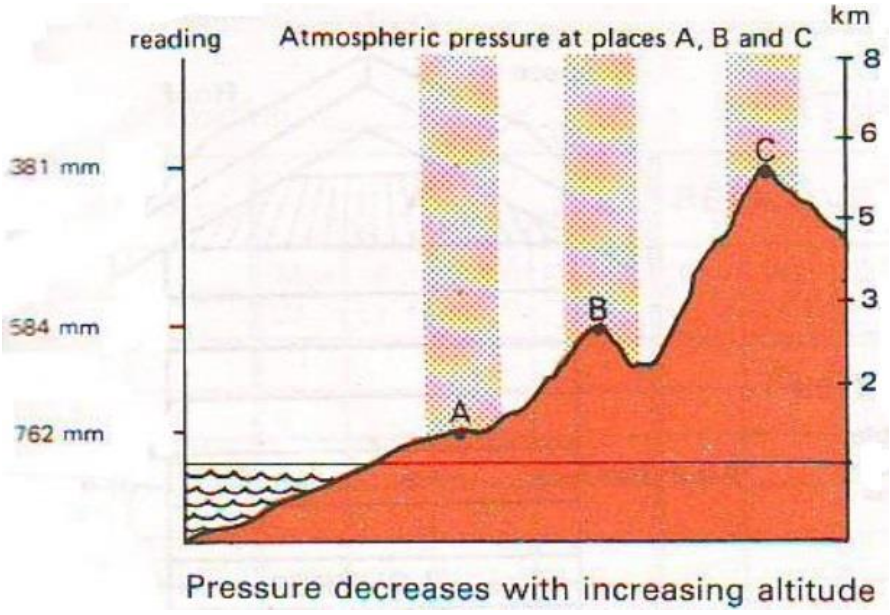
a. Temperature

Temperature and air pressure are closely related. Whenever temperature is high, air pressure decreases. As temperature increases, air gets heated. As air gets heated, it expands and becomes lighter. Such air tends to rise, causing air pressure on the earth surface to decrease.

b. Altitude

At high altitude area (like the mountaintop) has thin column of air above it. Thin air means few air molecules. Such air weighs less, hence low pressure. At lower altitude, the atmospheric gases are more compressed in comparison to the upper level. Thick air column in lower altitudes contains a greater number of molecules, which exert more pressure.

In other words, the layers of air at the bottom get pressed by the layers above them. So, the **lower layers have more pressure**, and the **higher layers have less** because they're not pressed as much. Therefore, air pressure **decreases as we go higher up.**



Pressure decreases with increasing altitude

c. Rotation

When the earth rotates, air which is confined to a small space at the polar regions is forced to move towards the Equator. As it moves and reaches the larger space nearer to the Equator, air pressure decreases. Again, rotation causes air from the larger area in the Tropics to be forced towards a confined (small) space at the poles. As a result, air pressure increases at the Polar Regions.

RELATIONSHIP BETWEEN ATMOSPHERIC PRESSURE AND WIND

Winds always blow from **areas of high pressure** to **areas of low pressure**. Air pressure also determines wind speed or wind strength. Difference in air pressure creates **pressure gradient**.

INTERPRETING ISOBARS ON AN AIR PRESSURE MAP

Isobars are lines joining places of equal air pressure on a **weather map**. A weather map is also called a **synoptic chart or isobaric map**. We see the weatherman on television using a weather map

Diagram of a weather map or synoptic chart

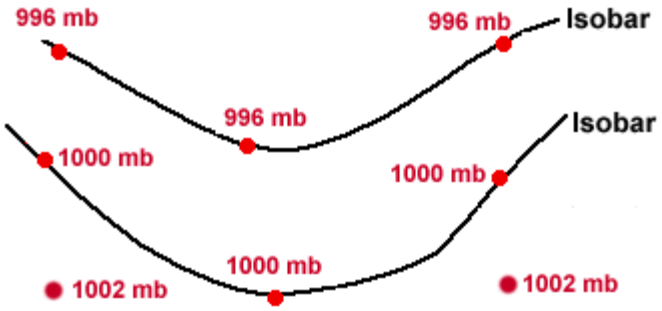


Figure 1 *Isobars on a weather map or synoptic chart*

When isobars are very close, it means **steep pressure gradient;** the pressure changes fast. With steep pressure gradient, strong winds will blow in the area.

When isobars are far apart, there is a gentle pressure gradient or the pressure changes slowly. As a result, weak winds will be experienced in the area. As a general rule, winds always from an area with closely spaced isobars to where isobars are far apart.

HOW TO DRAW ISOBARS ON AN ISOBARIC MAP (EXERCISE)

1. Draw a smooth line using a freehand joining all places of same air pressure.
2. Make sure line do **NOT** cross each.
3. Use letter **H** to indicate an area of high pressure. Use letter **L** to indicate an area of low air pressure.
4. Draw an **arrow** on the map showing wind direction.

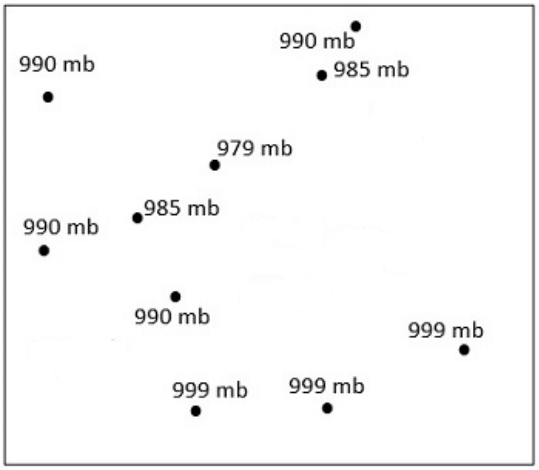


Figure 2 *Map showing air pressure in several places*

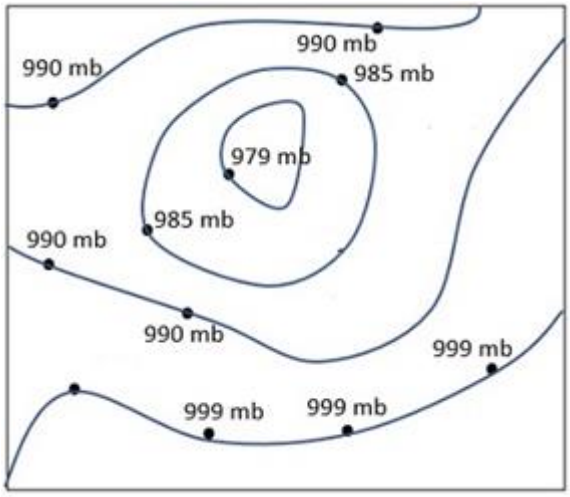


Figure 3 *Isobars joining places of equal air pressure*

WORLD PRESSURE BELTS

Pressure belt

A pressure belt is an area parallel to the latitudes that consistently experiences either high or low air pressure.

THE WORLD PRESSURE BELTS

- **a.** The Equatorial Low-Pressure Belt or Doldrums Low
- **b.** Sub-Tropical High-Pressure Belt or Horse Latitudes
- **c.** Temperate Low-Pressure Belt
- **d.** Polar High-Pressure belt

LOCATING THE MAIN PRESSURE BELTS ON WORLD MAPS

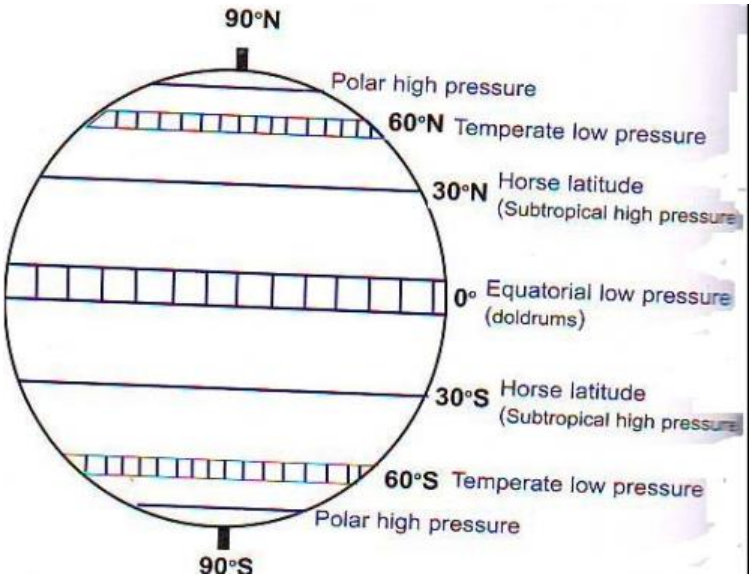


Figure 4 *World pressure belts*

CAUSES OF DIFFERENT TYPES OF PRESSURE BELTS or

ACCOUNT FOR THE DISTRIBUTION OF PRESSURE BELTS IN THE WORLD

a. <u>Equatorial Low or Doldrums</u>

This develops along the equator $\mathbf{0^0}$. It develops because of

- **high temperature which heats up the air, making it to rise and reducing the pressure**. Intense solar heat in the doldrums warms the trade winds causing the air to rise. As the air rises, it cools, causing showers and storms in the tropics. Since air rises, there are **no surface winds** over the region.

b. <u>Sub-Tropical High or Horse Latitudes</u>

Develops at $\mathbf{30^0}$ **N** and $\mathbf{30^0}$ **S** of the equator. A high pressure develops because of:

- sinking of air that moves from the equator.
- The air occupies a smaller space causing high pressure.
- At Sub-Tropical High-Pressure belts, air descends from upper atmosphere towards the earth. Such air is dry and NOT suitable for clouds to form. Areas along the Horse Latitudes receive no rainfall at all because of this. As such hot deserts like **Sahara, Australian, Arabian** and **Kalahari** deserts form.

d. <u>Temperate Low-Pressure Belt</u>

This develops at 60^0 North and South of the Equator. A low pressure develops in this region because

- air that moves from the Polar Regions meets the warmer air from the Tropics. When they meet, the warm air rises and when air rises, air pressure decreases.
- air from the poles occupies a larger space as it reaches the Temperate regions causing a drop in air pressure.

e. <u>Polar High-Pressure Belt</u>

This develops at **90^0N** or South of the equator. The high pressure develops because of

- extremely low temperatures in Polar Regions which makes air to contract thereby making the pressure to rise.
- air occupies a very small space causing air pressure to increase.

DIAGRAM OF PRESSURE BELTS AND MOVEMENTS OF WINDS ON THE GLOBE

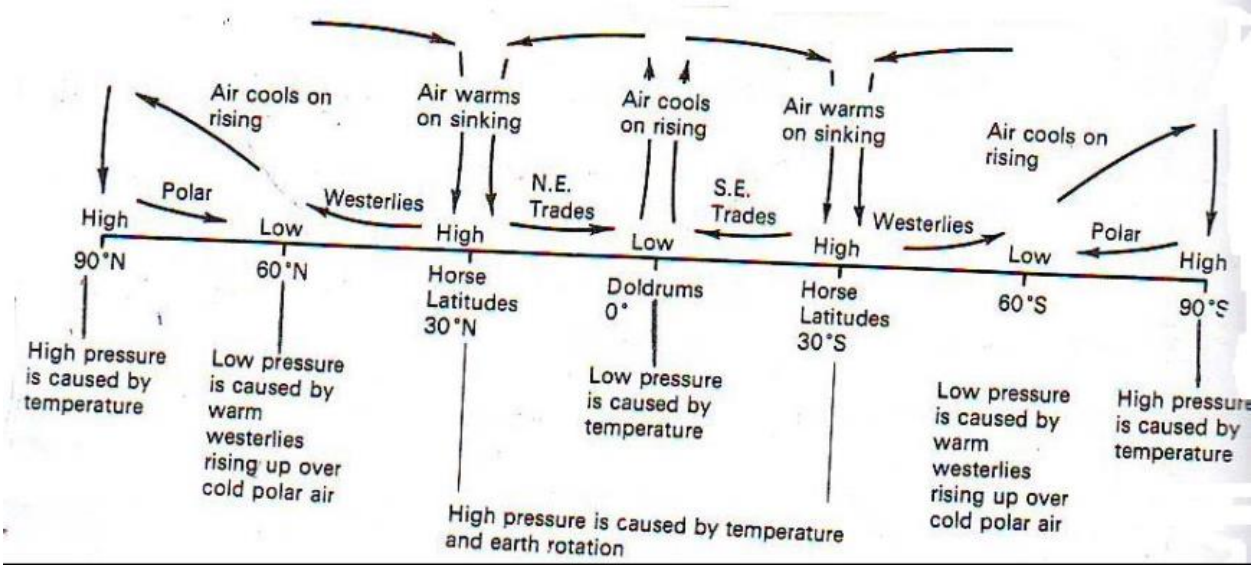


Figure 5 *Pressure belts and movement of prevailing winds*

New Topic: PREVAILING WINDS

What are prevailing winds?

A prevailing wind is a wind which blows more frequently from specific direction in a particular area.

TYPES OF PREVAILING WINDS

- **a.** The polar winds
- **b.** The westerlies
- **c.** Trade winds

The prevailing winds blow from **high pressure belts** towards **low pressure belts** and their direction is affected by the rotation of the earth.

PREVAILING WINDS ON STATIONARY GLOBE (NOT ROTATING)

If the earth was **not** rotating, prevailing winds would be blowing in a straight path from one pressure belt to another as shown is the globe below.

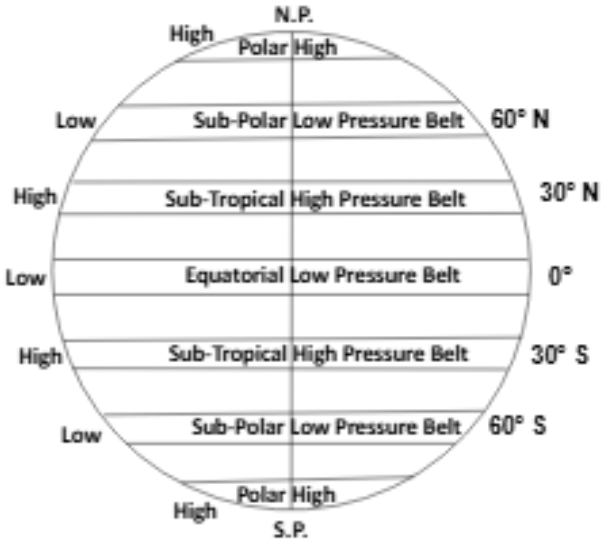


Figure 6 *Prevailing winds as they blow on stationary (non-rotating) globe*

PREVAILING WINDS ON A ROTATING GLOBE

How the Coriolis Effect affects movement of prevailing winds in the atmosphere.

FERREL'S LAW OF DEFLECTION

This law states that when the earth is rotating, it creates ***Coriolis force*** which deflects (changes direction of) all freely moving objects to the **right in a clockwise direction** in the northern hemisphere and to the **left in an anticlockwise direction** in the southern hemisphere.

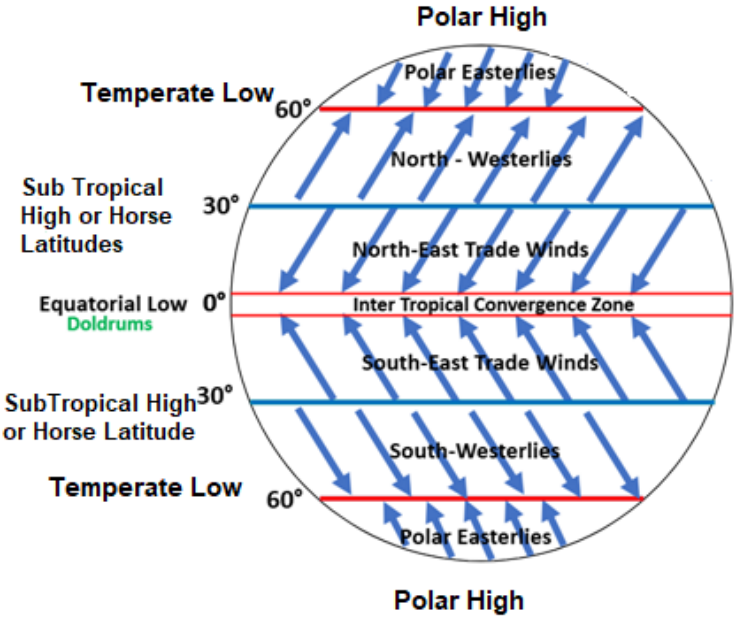


Figure 7 *Prevailing winds as they blow on a rotating globe*

1. **TRADE WINDS**

They blow towards the Equator from the 30-degree latitudes. In the northern hemisphere, the blow from the North East, so we call them **North East Trade Winds**.

In the Southern Hemisphere, they blow from the South East, so we call them **South East Trade Winds**.

CHARACTERISTICS OF TRADE WINDS

- **a.** They are warm winds moist enough to produce heavy rains.
- **b.** They blow from an easterly direction.
- **c.** They converge (meet) at the Equator producing convectional storms that produce dense clouds and heaviest rains.

IMPORTANCE OF THE TRADE WINDS

- **a.** Ships use less fuel and move faster as the Trade winds push them forward.
- **b.** Steadiness of the winds generally brings clear weather, making it favourable for mariners.
- **c.** They help in generating wind power.
- **d.** The trade winds bring tropical storms known as cyclones.

e. They cause surface ocean currents.

2. WESTERLIES

The westerlies generally blow from the subtropical high-pressure areas (horse latitudes) towards the 60^0 latitudes in both the Northern and Southern Hemispheres.

CHARACTERISTICS OF WESTERLIES

a. They blow from a westerly direction due to the deflecting effect of the earth's rotation; hence they are called the **westerlies**.
b. They are warm winds.
c. They are strongest in the winter when the pressure is lower over the poles and weakest during the summer and when pressures are higher over the poles.
d. They are moist winds since they originate from wet surface regions.

Importance of the westerlies

a. The westerlies bring warm weather and warm equatorial waters to the western coasts of continents.
b. They are useful in shipping, yacht races and aviation. Flying in the easterly direction is assisted by the winds; hence it requires less fuel and shorter travel time.

3. POLAR EASTERLIES

These winds blow persistently from the poles towards the equator. They are formed as cold air at the poles sinks and begins to move towards the Equator. The polar winds meet with the westerlies at around 60^0 latitudes in both hemispheres, causing violent storms and various weather changes.

CHARACTERISTICS OF POLAR EASTERLIES

a. They blow from **polar high-pressure belts** to temperate **low-pressure belts**.
b. They are winds of extremely cold air.
c. They are dry since the surface moisture in areas they originate from is frozen due to cold temperatures.
d. They blow from an easterly direction. The deflection of the winds to the west in each hemisphere causes the polar winds to blow from an easterly direction.
e. Polar easterlies are often weak and irregular.

IMPORTANCE OF THE POLAR EASTERLIES

a. When the cold polar easterlies meet with the warm westerly winds they create a polar front, a region of mild and moist winds that brings about precipitation. This is known as a temperate climate which is found in areas at the mid-latitudes.

HOW PRESSURE BELTS INFLUENCE WINDS AND WEATHER

Areas of high pressure are characterized by **calm winds**, **sunny** or **clear skies**, and little or no **precipitation** (rainfall or snowfall).

Areas of low pressure are **cloudy** and experience **rains** because winds converge and rise to form clouds.

IMPORTANCE OF PREVAILING WINDS

1. Good **in air transport** when aeroplanes **move following the direction** of the prevailing winds arriving faster and cutting fuel expenses.

2. Help to **bring rainfall** to some areas. For example, trade winds bring **convectional rainfall** to the tropics while westerly and polar bring **frontal rainfall** to **temperate low-pressure areas.**

3. Help in **shipping transport** as ships the cheapest form of transport take advantage of such winds by sailing following their direction and **moving faster.**

4. Causes ocean currents on the world's oceans.

PROBLEMS CREATED BY THE PREVAILING WINDS

1. Associated with **cyclones and depressions** which are very **destructive**, for example trade winds and westerlies.

2. **Slow down air transport** when aeroplanes move against them.

3. Create **strong currents** in oceans which apart from making **ships to delay**, pose a threat to shipping industry in terms of accidents thereby losing **goods** and **killing people**.